TASK 1 TECHNICAL MEMORANDUM

DATE: 8 August 2007

TO: California Coastal Conservancy

ATTENTION: Michael Bowen

FROM: Stillwater Sciences

SUBJECT: Biological rationale for a proposed reservoir drawdown period for Klamath River dams

1   INTRODUCTION

There are four dams on the Klamath River located between river miles 196 and 225 that are under consideration for removal: Iron Gate, Copco 1 and 2, and J.C. Boyle. Preliminary analyses indicate that there are approximately 15 to 21 million cubic yards of sediment stored within the reservoirs impounded by these four dams (Eilers and Gubala 2003, GEC 2006), most of which is silt and clay. Currently proposed dam removal options would result in up to four million cubic yards of that material being eroded into downstream reaches of the Klamath River, resulting in high suspended sediment loads and possibly localized short-term sediment deposition, both of which will have deleterious effects on aquatic habitats and species. The Conservancy has asked Stillwater Sciences to examine alternative drawdown periods, and select a biologically optimum period for beginning reservoir drawdown.

A preliminary review of the record indicates that the optimum time to commence drawdown, and begin releasing high Total Suspended Sediment (TSS) levels downstream of Iron Gate, is between 15 November and 1 December. This Technical Memorandum provides a rationale for the selection of that drawdown period. Future work by Stillwater will include a detailed analysis on the physical properties and concentrations of suspended sediment concentrations within the Klamath River that would result from sediment releases, as well as the predicted biological effects of such concentrations on aquatic habitats and species based on the assumption of dam removal during this time period. If it becomes apparent that this start date is unacceptable from the perspective of sediment transport trends and biological effects, additional drawdown periods will be more thoroughly revisited and analyzed.

2   BIOLOGICAL RATIONALE

Turbidity in the mainstem Klamath River below Iron Gate Dam caused by the initiation of drawdown is expected to be acute and lethal to many species that are present at that time. Stillwater conducted an analysis of the life history timing and distribution for selected, potentially

vulnerable aquatic species in the Klamath River basin to identify a time period when turbidity impacts would cause the least amount of harm (additional species will likely be analyzed during subsequent analysis). The following species were initially considered:

- Coho salmon
- Chinook salmon (spring and fall)
- Steelhead (summer and fall/winter)/rainbow trout
- Green sturgeon
- Pacific lamprey

Based on a preliminary analysis, spring appears to be the season most sensitive to increased turbidity because fry, smolts, or adults of many species are either rearing or migrating in the mainstem river during this period (Table 1). Summer is also a sensitive time period, based on potential impacts to adult green sturgeon, late-migrating salmon smolts, and rearing fish that are already compromised from stress due to high water temperatures or degraded water quality. The early to mid-fall period is also a sensitive period because of the presence of migrating and spawning adult salmon, particularly fall Chinook salmon spawning in mainstem reaches. Although a portion of coho salmon and steelhead continue to migrate upstream during November and December, a portion of the population should have reached refugia in tributary habitat by late November. Thus, winter was selected as the most reasonable period for the start of dam removal. This period coincides with periods of higher instream flow, thereby providing greater dilution, and reducing the risk of spring sediment releases as discussed below, and presented in the accompanying technical memorandum regarding sediment transport.

Life-history timing information for the mainstem Klamath River is provided in Table 1; however, it should be noted that the majority of the population for certain life stages of species listed are primarily distributed in tributary reaches rather than mainstem reaches. In particular, although coho salmon spawning and incubation occurs during winter, the majority of natural spawning is in tributaries. Peak adult Pacific lamprey migrations begin in the winter; however, these migrations occur all year and spawning does not begin until late March. Winter is also the period that aquatic species have evolved to survive increased amounts of acute turbidity, and thus dam removal resulting in increased turbidity during winter will be ecologically consistent with the natural fluctuations in the basin.

Table 1. Summary of life history timing[1] for selected fish species in the Klamath River downstream of Iron Gate Dam. Peak life history periods are shown in black.

Life stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coho salmon												
Incubation	▓	▓	▓	▓	▓						▓	▓
Emergence			▓	█	█							
Rearing	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Juvenile outmigration			▓	▓	█	▓						
Adult migration									▓	█	▓	▓
Spawning	▓										█	█
Spring Chinook salmon (Types I and II)												
Incubation									▓	▓	▓	▓
Emergence			▓	█								
Rearing			▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Juvenile outmigration										█	▓	
Adult migration		▓	▓	▓	▓	▓						
Spawning									▓	█	▓	

Life stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spring Chinook salmon (Type III)												
Incubation	▓	▓	▓	▓	▓	▓			▓	▓	▓	▓
Emergence			▓	█	▓							
Rearing	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Juvenile outmigration	▓	▓	▓	▓	▓	▓	▓					
Adult migration		▓	▓	▓	▓	▓						
Spawning									▓	█▓	▓	
Fall Chinook salmon (combined Types I and II)												
Incubation	▓	▓	▓	▓						▓	▓	▓
Emergence	▓	▓	▓	▓								
Rearing	▓	▓	▓	▓	▓	▓	▓	▓				
Juvenile outmigration				▓	▓	█	█	▓				
Adult migration							▓	█▓	▓	▓	▓	▓
Spawning									▓	█▓	▓	▓
Steelhead (summer)												
Incubation	▓	▓	▓	▓	▓						▓	▓
Emergence	▓	▓	▓	▓								
Rearing	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Juvenile outmigration				▓	█	█	▓					
Half-pounder residence	▓	▓	▓	▓								
Adult migration	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Spawning	▓	▓	▓								▓	▓
Runbacks			▓	▓	█▓	▓						
Steelhead (fall/winter)												
Incubation	▓	▓	▓	▓	▓						▓	▓
Emergence	▓	▓	▓	▓	▓						▓	▓
Rearing	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Juvenile outmigration				▓	█	█	▓					
Half-pounder residence	▓	▓	▓								▓	▓
Adult migration	▓	▓	▓					▓	▓	▓	▓	▓
Spawning	▓	▓	█	█	▓	▓						
Runbacks			▓	▓	▓							
Green sturgeon												
Incubation/emergence			▓	▓	▓	▓	▓	▓				
Rearing	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Juvenile outmigration					▓	▓	█	▓				
Adult migration			▓	█	█	█	▓					
Spawning			▓	▓	█	█	▓					
Pacific lamprey												
Incubation			▓	▓	▓	▓	▓	▓				
Rearing	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Juvenile outmigration[1]	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Adult migration	█	█	█	█	█	█	▓	▓	▓	▓	█	█
Spawning				▓	▓	▓						

[1] Includes both ammocoete and eyed juvenile outmigration.

Conceptual-level analyses by GEC (2006) and Gathard (2007) for the Klamath River downstream of Iron Gate Dam indicate that a total suspended sediment concentration of up to 20,000 ppm that lasts for approximately two weeks may occur if reservoir drawdown starts on 1 October, or up to 10,000 ppm that lasts for one month if reservoir drawdown starts on 1 December.

Reservoir drawdown occurring during winter is complicated by the potential for high winter flows that could exceed the capacity of the tunnel that will be used to draw the reservoir down. If refilling occurs, it could result in a subsequent spike in turbidity during the spring following the emptying of the reservoirs, due to reservoir refilling. Therefore, a balance was sought between identifying an optimal start date and the desire to minimize both the potential for a turbidity spike in spring and the impacts to the peak period of adult salmon migrations. The result was the selection of a reservoir drawdown starting date as late as possible in the period between 1 October and 1 December, most likely between November 15 and December 1.

Stillwater's later analysis will be used to predict potential suspended sediment concentrations within the Klamath River that would result from sediment releases associated with a late fall/early winter drawdown scenario. It will also be used to assess the likely effects of such concentrations on aquatic habitats and species; including aquatic species not considered during preliminary analyses. In particular, analysis will focus on identifying: (1) the portion of the Pacific lamprey and coho salmon runs expected to reach tributary refugia habitat and spawn successfully, (2) which life stage(s) of a given population will be most affected, and (3) the potential long-term impacts to populations. Analyses will also be used to identify potential measures to avoid, offset, or reduce impacts from sediment release following dam removal, and will focus on species that may be particularly susceptible (such as Pacific lamprey and coho salmon). If a more detailed analysis concludes that coho salmon or other aquatic species will not thrive in the long-term following a late fall/early winter dam removal date, and measures cannot be identified to alleviate potential impacts, then an alternate start date will be considered and analyzed.

3   REFERENCES

Eilers J. M., and C. P. Gubala. 2003. Bathymetry and sediment classification of the Klamath Hydropower Project impoundments. Prepared by J. C. Headwaters, Inc. for PacifiCorp, Portland, Oregon.

Gathard, D. 2007. Evaluation of alternatives to reservoir lowering start date from those proposed in November 2006. Klamath River Dam removal study, alternative start date analysis. Federal Energy Regulatory Commission report. GEC, Seattle, Washington.

GEC (Gathard Engineering Consulting). 2006. Klamath River dam and sediment investigation. Final report. GEC, Seattle, Washington.